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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

INTERFACE CONTROL DOCUMENT

UHF RADIO EQUIPMENT/RADIO INTERFACE UNIT

The NEXCOM Integrated Product Team, AND-360

RECORD OF CHANGES

Revision	Date	Action
0.0	4/16/2002	Version 0.6 UHF/RIU Draft Baselined as Revision 0.0

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1.0 INTRODUCTION

1.1 Scope

This Interface Control Document (ICD), is prepared in accordance with FAA-STD-025d. This ICD describes the design characteristics for an interface between the Radio Interface Unit and UHF Radio Equipment (URE). The RIU interfaces are depicted in figure 1-1 below and consist of one Ground Network Interface (GNI), up to four Multimode Digital Radios (MDRs) and up to 16 UHF radios.

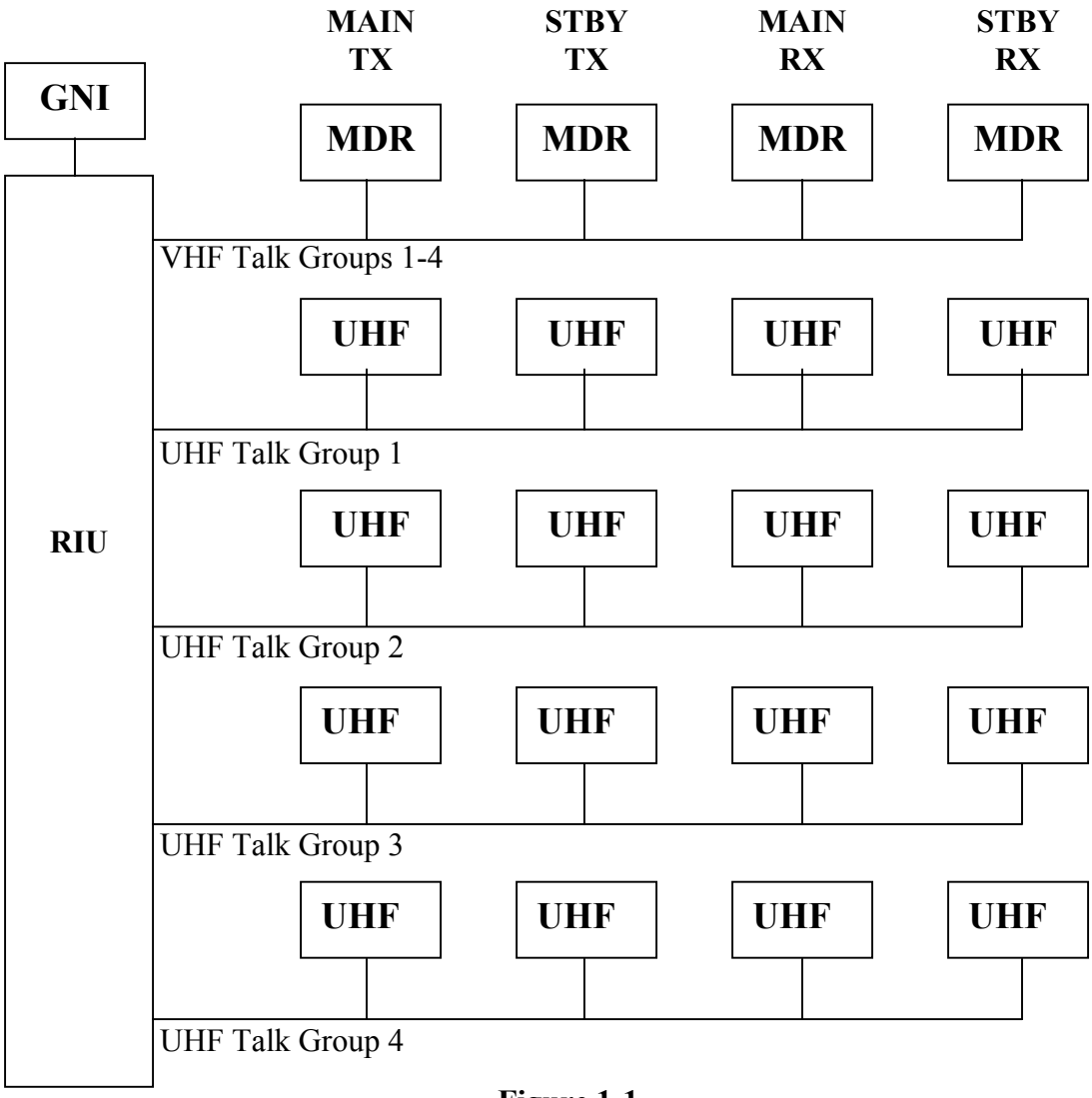


Figure 1-1

Subsystem Configuration

The four MDRs consist of a main and standby transmitter and a main and standby receiver supporting up to four TDMA slots or talk groups. The UHF radios consist of a main and standby transmitter and a main and standby receiver for each talk group with four talk groups

needing 16 UHF radios. A UHF radio replacement program is currently underway which will provide new DSB-AM UHF radios with additional capabilities beyond the legacy radios. One of these new capabilities is the inclusion of Maintenance Monitoring and Control (MMC) interface(s) which have yet to be fully defined. URE is defined to consist of the pieces of equipment in Table 1-1 below.

Table1-1

UHF Radio Equipment

FAA Type Number	Description	Manufacturer
AN/GRT-22	UHF Transmitter	ITT
AN/GRT-24	UHF Receiver	ITT
FA-10451	CM 200 UHF Transmitter	Motorola
FA-10453	CM 200 UHF Receiver	Motorola
TBD	UHF Transmitter - Replacement	TBD
TBD	UHF Receiver - Replacement	TBD
FA-10440/4	M/S Transmit Relay Panel	Northwest Mountain Region F&E / TSSC Fabrication Shop
FA-10440/6	M/S Receive Relay Panel	Northwest Mountain Region F&E / TSSC Fabrication Shop
N/A	Keying Voltage Source	Various

1.2 Subsystem Responsibility List

Table1-2

Subsystem Equipment Responsibility

Subsystem/Equipment	Common Name	Responsible Organization
Radio Interface Unit	RIU	AND-360
Ultra High Frequency (UHF) Radio Equipment	UHF Radios and Antenna Transfer Relay (ATR) Panels	AND-360

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this ICD to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this ICD, the contents of this ICD **shall** be the superseding requirements.

2.1 Government Documents

2.1.1 Federal Aviation Administration

2.1.1.1 Standards

Doc No.	Document Title	Version / Date[1]
FAA-STD-025d	Preparation of Interface Documentation	October 1995

2.1.1.2 Specifications

Doc No.	Document Title	Version / Date[2]
FAA-G-2100g	Electronic Equipment, General Requirements	October, 2001
FAA-E-XXXX	Subsystem Specification for the Radio Interface Unit	Date TBD
FAA-E-YYYY	UHF Replacement Radio MMC Interface Specification	Date TBD
FAA-PD-130-TX	Purchase Description, VHF/UHF AM Air/Ground Radio Communication Transmitters (Thru Modification 8)	September 22, 1994
FAA-PD-130-RX	Purchase Description, VHF/UHF AM Air/Ground Radio Communication Receivers (Thru Modification 8)	September 22, 1994
T. O. 31R2-2GRT-102 NAVALEX 0967-LP-429-5015	Technical Manual, Transmitting Set, Radio, AN/GRT-21(V) and AN/GRT-22(V), Change 6	December 15, 1983
T. O. 31R2-2GRR-112 NAVALEX 0967-LP-428-1010	Technical Manual, Receiver, Radio, AN/GRR-23(V) and AN/GRR-24(V), Change 2	July 15, 1981
FAA-P-2956, V1	Product Description, Ultra High Frequency (UHF) Receivers and Transmitters	February 1, 2002

[1] Dates and versions are the latest that could be found.
[2] Dates and versions are the latest that could be found.

2.2 Document Sources

2.2.1 Source of FAA Documents

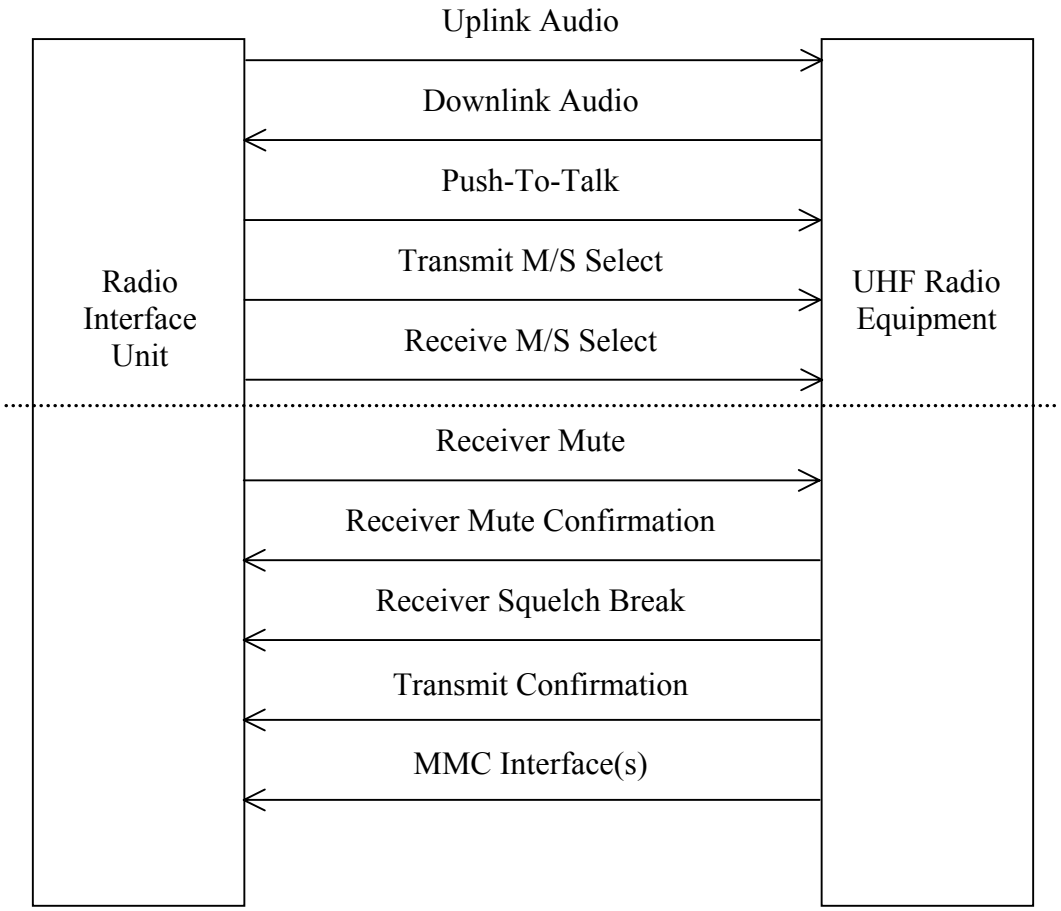
Copies of FAA specifications, standards, and publications may be obtained from the Contracting Officer, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C., 20591. Requests should clearly identify the desired material by number and date, and state the intended use of the material.

3.0 INTERFACE DESIGN CHARACTERISTICS

3.1 General Characteristics

This ICD describes the interface design characteristics between the Radio Interface Unit and UHF Radio Equipment. Figure 3-1 illustrates the functional connectivity between these two subsystems.

a) The RIU **shall** provide connectivity for all functions in figure 3-1.



Note: Functions below the dashed line are new capabilities incorporated into the UHF Replacement Radios.

Figure 3-1

RIU/URE Functional Connectivity

3.2 Functional Design Characteristics

3.2.1 Application Processes

The UHF Replacement Radios will have an MMC interface(s). The application processes which are a part of this interface will be defined in the MDT-UHF Replacement Radio ICD to

be provided by the radio vendor. Contract award for that program is scheduled for October of 2002.

3.2.2 OSI/IPS-Type Interface

The UHF Replacement Radios will have an MMC interface(s). The OSI/IPS (Open System Interconnection / Internet Protocol Suite) components which will be a part of this interface will be defined in the MDT-UHF Replacement Radio ICD to be provided by the radio vendor. The physical layer is defined as an RS-232 serial interface. There may be as many as 16 individual MMC physical interfaces (one per UHF Replacement Radio) or they might possibly be daisy-chained together as a single physical interface.

3.2.3 Analog-Type Interface

The analog portion of this interface involves the uplink and downlink audio paths between the RIU and URE. Table 3-1 identifies the analog signal paths and their directions. The electrical characteristics of each are described in the following subsections.

a) The RIU **shall** provide connectivity for all signals in table 3-1.

Table 3-1

Analog-Type Interfaces

Identification	Quantity	Direction
Main Audio Uplink	4	RIU to URE Main TX
Standby Audio Uplink	4	RIU to URE Standby TX
Main Audio Downlink	4	URE Main RX to RIU
Standby Audio Downlink	4	URE Standby RX to RIU

3.2.3.1 UHF Audio Interface

a) Each audio interface for the UHF radio **shall** consist of a transformer coupled, two-wire balanced circuit with an impedance of 600 Ohms ± 10 %, isolated from ground.

3.2.3.2 Audio Frequency Response

a) The frequency response of each audio interface **shall** be flat from 300 Hz to 3000 Hz to within ± 1 dB relative to the level at 1 kHz.

3.2.3.3 Receive Audio Level

a) The receive audio level **shall** be -8 dBm ± 1.5 dB.

3.2.3.4 Transmit Audio Level

a) The transmit audio **shall** have an average level between -13 dBm and -8 dBm during any three second period regardless of the level of the source audio from the Voice Switch or the front panel microphone.

3.2.4 Discrete-Type Interface

The discrete interface involves the control and confirmation signals between the RIU and URE other than those which are part of the yet to be defined MMC interface. Table 3-2 identifies the discrete signal paths and their directions. It also subdivides the signals into those common to all URE and those which are only present in the UHF Replacement Radios. The electrical characteristics of each are described in the following subsections.

a) The RIU **shall** provide connectivity for all signals in table 3-2.

Table 3-2
Discrete-Type Interfaces

Identification	Quantity	Signal Flow
Main PTT	4	RIU to URE Main TX
Standby PTT	4	RIU to URE Standby TX
TX Main/Standby Select	4	RIU to URE M/S TX Relay Panel
RX Main/Standby Select	4	RIU to URE M/S RX Relay Panel
Signals Below Are For UHF Replacement Radios Only		
Main RX Mute	4	RIU to URE Main RX
Standby RX Mute	4	RIU to URE Standby RX
Main RX Mute Confirmation	4	URE Main RX to RIU
Standby RX Mute Confirmation	4	URE Standby RX to RIU
Main RX Squelch Break	4	URE Main RX to RIU
Standby RX Squelch Break	4	URE Standby RX to RIU
Main TX Confirmation	4	URE Main TX to RIU
Standby TX Confirmation	4	URE Standby TX to RIU

3.2.4.1 Common Signals

The following signals are common to both legacy and replacement UHF Radios.

3.2.4.1.1 Transmitter Keying (Push-to-Talk [PTT])

a) Two UHF PTT signals **shall** be present for each frequency (talk group) – one for each transmitter.
b) Both UHF transmitters in a talk group **shall** not be keyed simultaneously.

Note: An MDR transmitter and UHF transmitter can be (and usually are) keyed simultaneously by the controller. MDR keying is not part of this interface.

c) UHF Transmitters are deployed using either voltage or ground keying. The RIU **shall** supply an isolated relay contact closure capable of carrying at least 100 mA of current.
d) The transmitter **shall** be keyed when the contacts are closed and un-keyed when the contacts are open.

3.2.4.1.2 Main/Standby Select

a) The main/standby select signals are applied to the antenna transfer relays (ATRs) of the M/S Transmit Relay Panel and the M/S Receive Relay Panel respectively, rather than the UHF radios themselves. Both ATR coils are tied to a nominal voltage of + 24 VDC with a maximum of + 30 VDC and a minimum value of + 20 VDC which **shall** be supplied by the RIU.
b) Two control signals (open collector or normally open relay type) **shall** be present for each talk group - one for the transmitter relay and one for the receiver relay. These signals are not mutually exclusive as the transmitter keying signals are.
c) Main **shall** be the default state (antenna transfer relay open).
d) Main **shall** be selected by applying a high impedance to the line, i.e. the transistor is off or "relay" contacts are open.
e) Standby **shall** be selected (antenna transfer relay closed) by applying and continuously maintaining a low impedance capable of sinking up to 100 mA of current from the ATR coil, i.e. the transistor is turned on or "relay" contacts are closed.

3.2.4.2 New Signals

The following signals are new for the UHF Replacement Radios only.

3.2.4.2.1 Receiver Mute

a) Two signals **shall** be present for each talk group, one for each UHF Receiver.
b) Receiver Mute **shall** be active when a ground is applied to this line and inactive when an open is applied.
c) The RIU **shall** supply a ground at 0 VDC ± 1V capable sinking 0.5 mA at up to 40 VDC for activation of Receiver Mute.
d) The RIU **shall** supply an open circuit to this line to disable Receiver Mute.

3.2.4.2.2 Receiver Mute Confirmation

a) Two signals **shall** be present for each talk group, one for each UHF Receiver.
b) The RIU **shall** detect a short circuit (1 Amp max @ up to 80 VDC) as a Receiver Mute Confirmation.
c) The RIU **shall** detect an open circuit on this line as the absence of Receiver Mute Confirmation.

3.2.4.2.3 Receiver Squelch Break

a) Two signals **shall** be present for each talk group, one for each UHF Receiver.
b) The RIU **shall** detect a short circuit (1 Amp max @ up to 80 VDC) as a Receiver Squelch Break.
c) The RIU **shall** detect an open circuit on this line as the absence of Receiver Squelch Break.

3.2.4.2.4 Transmit Confirmation (Contact Closure)

a) Two signals **shall** be present for each talk group, one for each UHF Transmitter.

b) The RIU **shall** detect a short circuit (1 Amp max @ up to 80 VDC) as a Transmit Confirmation (i.e. transmitting) Signal.
c) The RIU **shall** detect an open circuit on this line as the absence of Transmit Confirmation (i.e. not radiating) Signal.

3.2.5 Interface Design Characteristics

Not applicable to this ICD.

3.3 Physical Requirements

3.3.1 Electrical Power/Electronic Requirements

The requirements specified in this section are described in accordance with FAA-G-2100g: *Electronic Equipment General Requirements*.

3.3.1.1 Connectors

a) The RIU and URE **shall** interface physically through the means of punch-down blocks.
b) The configuration of the RIU connector is not restricted by this ICD but it **shall** support the use of solid wire suitable for use with 110 and 66 type punch-down blocks.

3.3.1.2 Wire/Cable

TBD. Some restrictions to cable length may apply when the MMC interface(s) to the UHF replacement radios is defined.

3.3.1.3 Electrical Power/Electronic Referencing (Grounding)

a) A nominal voltage of + 24 VDC with a maximum of + 30 VDC and a minimum value of + 20 VDC **shall** be supplied by the RIU to the URE interface for use by the ATRs.
b) The voltage source for PTT **shall** be supplied by the URE.
c) The radios and RIU **shall** share a common ground reference which will provide the return path for some of the control signals.

3.3.1.4 Fasteners

Not applicable to this ICD.

3.3.1.5 Electromagnetic Compatibility

a) The RIU design **shall** be such that conducted and radiated EMI/RFI at the RIU/URE interface does not impair or degrade operation of this interface. See FAA-G-2100g, Section 3.3.2.

4.0 QUALITY ASSURANCE PROVISIONS

Compliance with the requirements stated in this ICD are deemed met when all the requirements specified in a paragraph are verified by one or more of the methods outlined in the subsequent subparagraphs.

a) The results of the verification activities **shall** be expressed as either pass or fail.

4.1 Responsibility For Verification

TBD.

4.2 Special Verification Requirements

Not applicable to this ICD.

4.3 Verification Requirements Traceability Matrix

a) Verification **shall** be in accordance with Table A-1, Verification Requirements Traceability Matrix (VRTM).

4.4 Verification Levels and Methods

The levels and methods of verification appropriate for use in the VRTM, presented in Section 4 of the ICD, are defined in the following paragraphs.

4.4.1 Verification Levels

a) SUBSYSTEM LEVEL. This level of verification is usually accomplished at the contractor's facility and culminates in the formal acceptance of a contractual end-item.
b) INTEGRATION-LEVEL. This level of verification is conducted at the FAATC, or at a key site. The verification conducted will determine if the hardware, software, or subsystem to be deployed for site installation will perform in a NAS environment and in accordance with NAS system-level operational and functional requirements.
c) SITE-LEVEL. This level of verification is usually performed at the designated site. The verification portion of the subsystem installation and checkout will emphasize demonstration of the overall system performance requirements. It includes the demonstration of an end-item, subsystem and/or system, the final acceptance demonstrations, and commissioning activities.

4.4.2 Verification Methods.

There are four verification methods that can be used at any of the three verification levels. Verification methods are:

a) INSPECTION. Inspection is a method of verification to determine compliance without the use of special test equipment, procedures, or services, and consist of a non-destructive static-state examination of the hardware, software, and/or the technical data and documentation.
b) TEST. Test is a method of verification wherein performance is measured during or after the controlled application of functional and/or environmental stimuli. Quantitative

measurements are analyzed to determine the degree of compliance to the success criteria stipulated in the ICD or project specification. The process uses standardized laboratory equipment, procedures, hardware, and/or services.

c) DEMONSTRATION. Demonstration is a method of verification where qualitative determination of properties is made for configuration items, including software, and/or technical data and documentation measured, in a dynamic state.

d) ANALYSIS. This method of verification consists of comparing hardware or software design with known scientific and technical principles, procedures, and practices to estimate the capability of the proposed design to meet the mission and system requirements. When certain elements of design are comprised of previously qualified elements such as commercial off the shelf (COTS) equipment, then analysis of previous qualification testing in meeting specification requirements may be used to reduce the amount of qualification testing.

5.0 PREPARATION FOR DELIVERY

This topic not applicable to this document.

6.0 NOTES

6.1 Definitions

This topic not applicable to this document.

6.2 Abbreviations and Acronyms

The list of abbreviations and acronyms may be found in appendix B.

APPENDIX A

Verification Requirements Traceability Matrix

Table A-1

Verification Requirements Traceability Matrix

(Verification Methods: D - Demonstration, I - Inspection, A - Analysis, T - Test, X - Not Applicable)

Section 3	Requirements	Verification Phase and Method			
		Sub-system Level	Integration Level	Site Level	Remarks
3.1	The RIU **shall** provide connectivity for all functions in figure 3-1.	I	I	I	
3.2.3	The RIU **shall** provide connectivity for all signals in table 3-1.	I	I	I	
3.2.3.1	Each audio interface for the UHF radio **shall** consist of a transformer coupled, two-wire balanced circuit with an impedance of 600 Ohms ± 10 %, isolated from ground.	T	T	T	
3.2.3.2	The frequency response of each audio interface **shall** be flat from 300 Hz to 3000 Hz to within ± 1 dB relative to the level at 1 kHz.	T	T	T	
3.2.3.3	The receive audio level **shall** be -8 dBm ± 1.5 dB.	T	T	T	
3.2.3.4	The transmit audio **shall** have an average level between -13 dBm and -8 dBm during any three second period regardless of the level of the source audio from the Voice Switch or the front panel microphone.	T	T	T	
3.2.4	The RIU **shall** provide connectivity for all signals in table 3-2.	I	I	I	
3.2.4.1.1 a.	Two UHF PTT signals **shall** be present for each frequency (talk group) – one for each transmitter.	T	T	T	
3.2.4.1.1 b.	Both UHF transmitters in a talk	T	T	T	

Section 3	Requirements	Verification Phase and Method			
	group **shall** not be keyed simultaneously.				
3.2.4.1.1 c.	The RIU **shall** supply an isolated relay contact closure capable of carrying at least 100 mA of current.	T	T	T	
3.2.4.1.1 d.	The transmitter **shall** be keyed when the contacts are closed and un-keyed when the contacts are open.	T	T	T	
3.2.4.1.2 a.	Both ATR coils are tied to a nominal voltage of + 24 VDC with a maximum of + 30 VDC and a minimum value of + 20 VDC which **shall** be supplied by the RIU.	T	T	T	
3.2.4.1.2 b.	Two control signals (open collector or normally open relay type) **shall** be present - one for the transmitter relay and one for the receiver relay.	T	T	T	
3.2.4.1.2 c.	Main **shall** be the default state (antenna transfer relay open).	T	T	T	
3.2.4.1.2 d.	Main **shall** be selected by applying a high impedance to the line, i.e. the transistor is off or “relay” contacts are open.	T	T	T	
3.2.4.1.2 e.	Standby **shall** be selected (antenna transfer relay closed) by applying and continuously maintaining a low impedance capable of sinking up to 100 mA of current from the ATR coil, i.e. the transistor is turned on or “relay” contacts are closed.	T	T	T	
3.2.4.2.1 a.	Two signals **shall** be present for each talk group, one for each UHF Receiver.	I	I	I	
3.2.4.2.1 b.	Receiver Mute **shall** be active when a ground is applied to this line and inactive when an open is applied.	T	T	T	
3.2.4.2.1 c.	The RIU **shall** supply a ground at	T	T	T	

Section 3	Requirements	Verification Phase and Method			
	0 VDC ± 1V capable sinking 0.5 mA at up to 40 VDC for activation of Receiver Mute.				
3.2.4.2.1 d.	The RIU **shall** supply an open circuit to this line to disable Receiver Mute.	T	T	T	
3.2.4.2.2 a.	Two signals **shall** be present for each talk group, one for each UHF Receiver.	I	I	I	
3.2.4.2.2 b.	The RIU **shall** detect a short circuit (1 Amp max @ up to 80 VDC) as a Receiver Mute Confirmation.	T	T	T	
3.2.4.2.2 c.	The RIU **shall** detect an open circuit on this line as the absence of Receiver Mute Confirmation.	T	T	T	
3.2.4.2.3 a.	Two signals **shall** be present for each talk group, one for each UHF Receiver.	I	I	I	
3.2.4.2.3 b.	The RIU **shall** detect a short circuit (1 Amp max @ up to 80 VDC) as a Receiver Squelch Break.	T	T	T	
3.2.4.2.3 c.	The RIU **shall** detect an open circuit on this line as the absence of Receiver Squelch Break.	T	T	T	
3.2.4.2.4 a.	Two signals **shall** be present for each talk group, one for each UHF Transmitter.	I	I	I	
3.2.4.2.4 b.	The RIU **shall** detect a short circuit (1 Amp max @ up to 80 VDC) as a Transmit Confirmation (i.e. transmitting) Signal.	T	T	T	
3.2.4.2.4 c.	The RIU **shall** detect an open circuit on this line as the absence of Transmit Indication (i.e. not radiating).	T	T	T	
3.3.1.1a	The RIU and URE **shall** interface physically through the means of punch-down blocks.	I	I	I	
3.3.1.1b	The configuration of the RIU connector is not restricted by this ICD but it **shall** support the use of	D	D	D	

Section 3	Requirements	Verification Phase and Method			
	solid wire suitable for use with 110 and 66 type punch-down blocks.				
3.3.1.3 a.	A nominal voltage of + 24 VDC with a maximum of + 30 VDC and a minimum value of + 20 VDC **shall** be supplied by the RIU to the URE interface for use by the ATRs.	T	T	T	
3.3.1.3 b.	The voltage source for PTT **shall** be supplied by the URE.	T	T	T	
3.3.1.3 c.	The radios and RIU **shall** share a common ground reference which will provide the return path for some of the control signals.	T	T	T	
3.3.1.5	The RIU design **shall** be such that conducted and radiated EMI/RFI at the RIU/URE interface does not impair or degrade operation of this interface.	T	T	T	

APPENDIX B

Abbreviations and Acronyms

B.1 Abbreviations and Acronyms

ATR	Antenna Transfer Relay
DSB-AM	Double Side Band – Amplitude Modulation
FAA	Federal Aviation Administration
ICD	Interface Control Document
IPS	Internet Protocol Suite
ISO	International Organization for Standardization
GNI	Ground Network Interface
MDR	Multi-mode Digital Radio
MMC	Maintenance Monitoring and Control
OSI	Open System Interconnection
PTT	Push-to-talk
RIU	Radio Interface Unit
UHF	Ultra-High Frequency
URE	UHF Radio Equipment